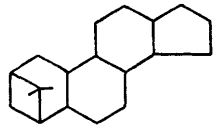
Preparation of 4-Alkylated Derivatives of Apopinene

By DANIEL JOULAIN* and CLAUDE MOREAU
(*Laboratoire de Synthèse Organique, Centre Universitaire du Mans, route de Laval, 72-Le Mans, France*)
and MICHEL PFAU
(*Laboratoire de Recherches Organique de l'Ecole Supérieure de Physique et de Chimie Industrielles, 10 rue Vauquelin, Paris 5e, France*)

Summary Coupling of Grignard reagents with bromo-apopinene, prepared by treatment of apopinene with NBS, gives 4-alkylated derivatives of apopinene in high yields; of particular interest is the convenient preparation of *trans*-δ-pinene.

WE report here a convenient stereospecific synthesis of new *trans*-4-substituted derivatives (**2**) of apopinene, possible key intermediates in syntheses of polycycles of type (**1**); these derivatives are also of potential interest for photochemical studies.[1]

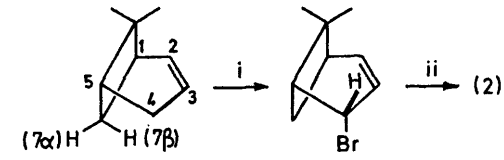
trans-Bromoapopinene (**4**), required as starting material in these syntheses, was prepared stereospecifically by treatment of apopinene (**3**) with *N*-bromosuccinimide (NBS) in almost quantitative yield based upon recovered apopinene (b.p. 80—81° at 20 mmHg).



(1)

(2)

The *trans*-configuration† of compound (**4**) results from a stereoselective attack by the brominating agent on the opposite side of the *gem*-dimethyl bridge,[3] and is supported by its n.m.r. spectrum, which shows a 0·3 p.p.m. deshielding of 7β-H (d, ^2J 9 Hz),[4] relative to the equivalent proton in apopinene, owing to through-space interaction with bromine.



(3) (4)

Reagents: i, NBS–CCl_4, hν; iii, Li_2CuCl_4–THF–RMgX, 0°. *Yields of* (**2**): for RMgX = MeMgI, 86%;§ EtMgBr, 81%;§ CH_2:C(Me)-CH_2MgCl, 88%;¶ $PhCH_2MgCl$, 86%;¶ m-$Me_3SiO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CH_2$-MgBr, 64% (*trimethylsilyl ether cleaved simultaneously*[6]).

Coupling of Grignard reagents with the allylic bromide (**4**), catalysed by Li_2CuCl_4 in THF solution at 0°,[5] afforded compounds of type (**2**) in high yield.‡ This method provides a much more convenient synthesis of pure *trans*-δ-pinene (**3**; R=Me) than those proposed before.[7].

(*Received, 14th July* 1972; *Com.* 1224.)

† Stereochemistry defined relative to the *gem*-dimethyl bridge.

‡ Satisfactory analytical and spectral data were obtained.

§ Yield based on purified product.

¶ Yield calculated from g.l.c. analysis.

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